

BRINGING EUROPE AND THIRD COUNTRIES CLOSER
TOGETHER THROUGH RENEWABLE ENERGIES



WP3 – North Africa Case Study Prospects for RES-E

Jürgen Kern, Franz Trieb

BETTER Regional Workshop,
28 October 2013, Rabat, Morocco

WP Leader: DLR



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BETTER WP3: North Africa Case Study for Morocco, Tunisia, Egypt, Algeria, Libya



3.1. Inventory of RES-E in NA countries (PIK)

- 3.1.1. Energy system characterization and RES(-E) deployment
- 3.1.2. Energy policy framework
- 3.1.3. Present Barriers for RES-E market introduction and expansion
- 3.1.4. Regional grid capacity and grade of interconnection

3.2. Prospects for renewable energy expansion for the NA countries – bottom-up assessment (OME)

- 3.2.1. Renewable energy potentials and related costs
- 3.2.2. Demand development scenarios
- 3.2.3. RES(-E) Policy targets in the short (2020) to long-term (2050) from national/regional viewpoint in NA countries
- 3.2.4. Estimated framework development
- 3.2.5. Technologically and economically feasible pathways for RES(-E) deployment
- 3.2.6. Environmental and Socio-economic impact assessment

3.3. Prospects for renewable energy exports from NA to EU (DLR)

- 3.3.1. Grid technology characterisation
- 3.3.2. Technical framework conditions
- 3.3.3. Role of renewable energy imports in Europe
- 3.3.4. Investments required for infrastructure
- 3.3.5. Technologically and economically feasible pathways for solar energy export from NA to EU until 2020 and beyond
- 3.3.6.: Environmental and Socio-economic impact assessment related to exports

3.4. Role and Design of the Cooperation Mechanisms (DLR)

- 3.4.1. Economic framework for the integration of renewable electricity in North Africa
- 3.4.2. Economic framework for the integration of renewable electricity imports from North Africa to Europe
- 3.4.3. Compatibility with other instruments
- 3.4.4. Design of the mechanisms
- 3.4.5. Assessment of the possible role of the cooperation mechanism from a host-country perspective

3.5. SWOT Analysis EU-North Africa with Energy Security Assessment (PIK)

- 3.5.1. Analysis of energy security risks related with the use of cooperation mechanisms
- 3.5.2. Analysis of the weaknesses with regard to cooperation mechanisms
- 3.5.3. Analysis of the strengths with regard to cooperation mechanisms
- 3.5.4. Analysis of the opportunities with regard to cooperation mechanisms

Task 3.6. Preparation of a case study report that summarizes results of WP3 (DLR)



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WP3 Timeline and Deliverables:



BM1

BM2

today

RWS

Phase / Duration of the action (in months)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
WP 3 - EU-North Africa Case study																														
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D3.1

D3.2

D3.3

D3.4

D3.5

D 3.1: Report on power system inventory E, T, M (L, A)

D 3.2: Report on future RES(-E) prospects in NA

D 3.3: Report on future RES(-E) prospects for export from NA to EU

D 3.4: Report about security aspects of RES(-E) imports from NA to EU

D 3.5: Final report on EU-NA Case Study

BM1: Bilateral Meeting Morocco

BM2: Bilateral Meeting Tunisia/Algeria

RWS: Regional Workshop



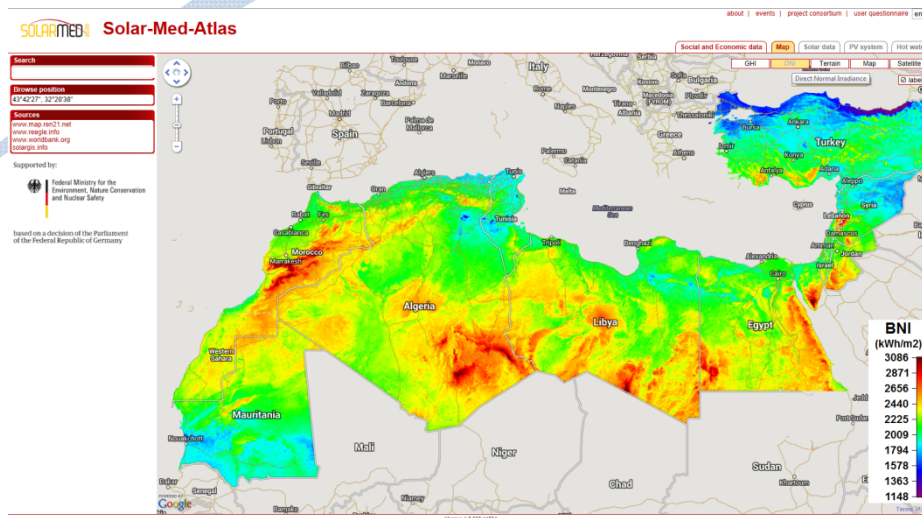
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3.2. Prospects for RES-E in NA

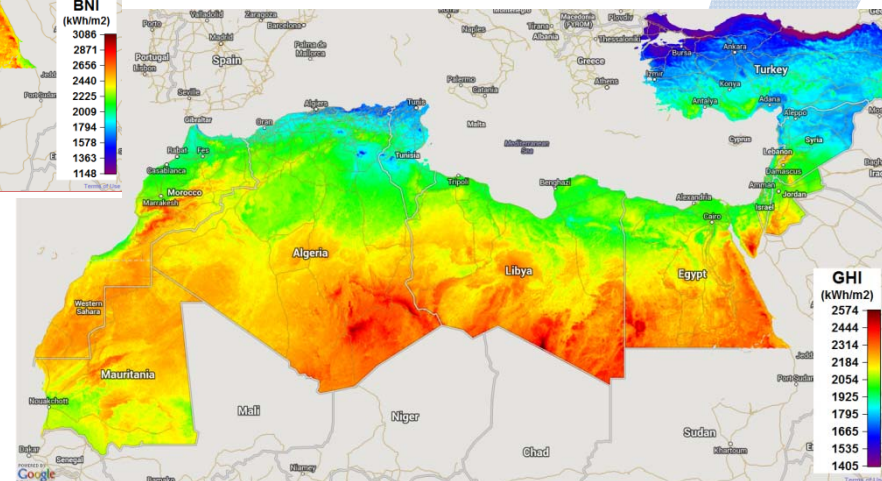
3.2.1: RE potential and related costs



1. RES-E cost database under discussion
2. RES-E potentials in NA analyzed (visualization in process)



www.solar-med-atlas.org



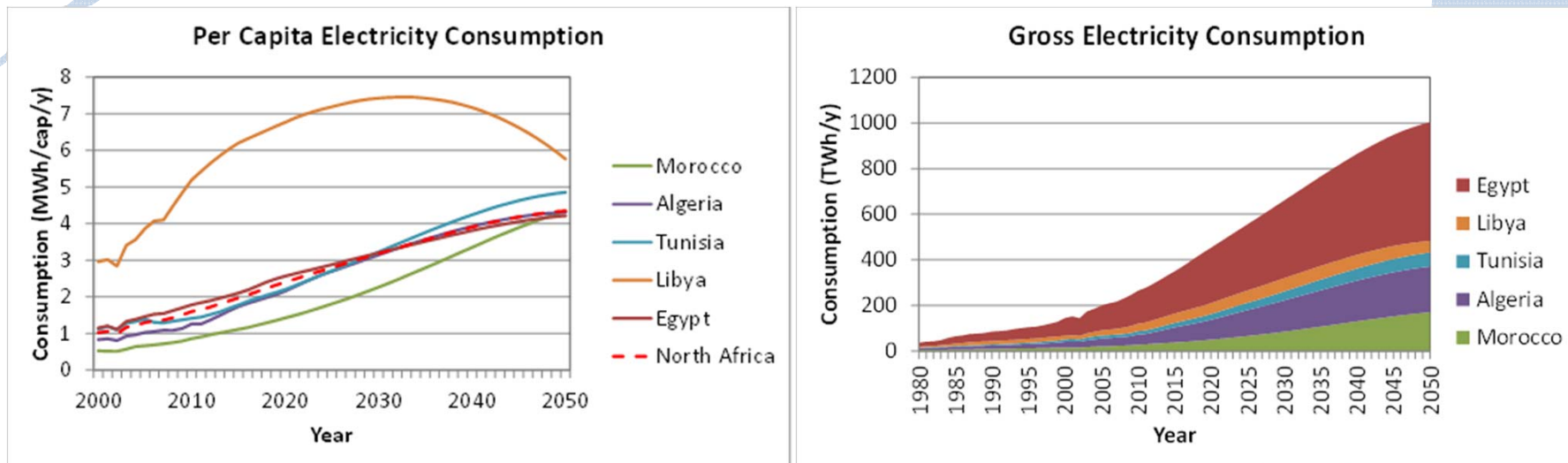
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3.2. Prospects for RES-E in NA

3.2.2: Demand development scenarios



1. Demand model for each country from 2000 to 2050
2. Empirical demand growth function based on population, GDP and efficiency gains



3.2. Prospects for RES-E in NA

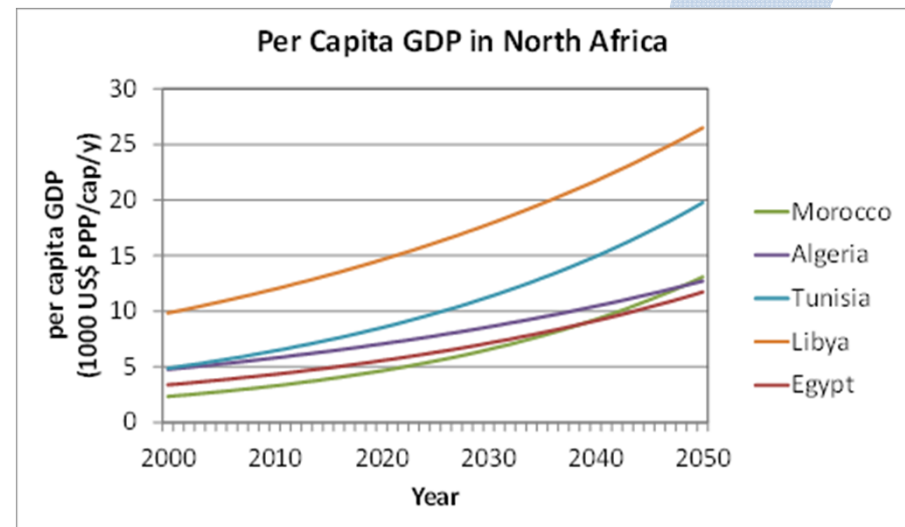
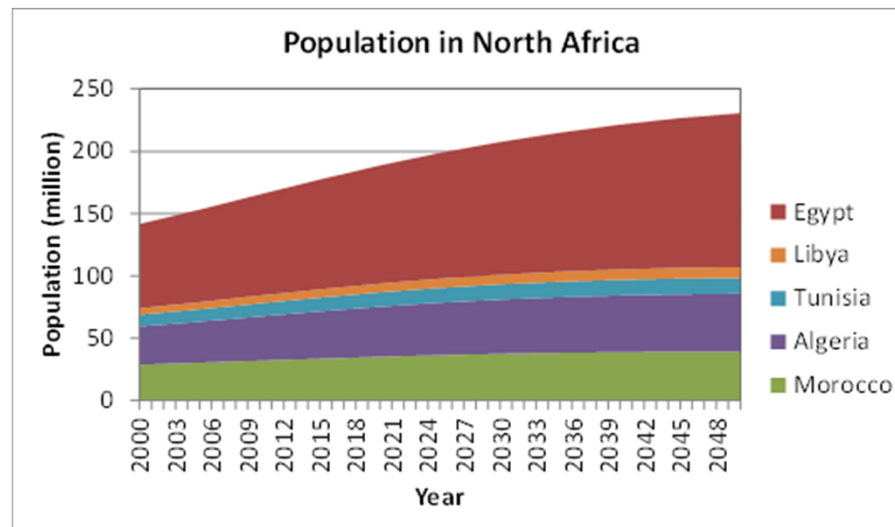
3.2.2: Demand development scenarios



Assumptions for GDP and Population:

- United Nations Population Prospects Medium Growth Scenario 2012
- International Monetary Fund 2012

Country	Per capita GDP Growth Rate MED-CSP Study 2005 %/y	GDP/cap 2003 MED-CSP Study 2005 US\$/cap/y	Per capita GDP Growth Rate Model Update 2010 %/y	GDP/cap 2010 Model Update 2010 US\$/cap/y
Morocco	4.6	2500	3.5	3290
Algeria	4.0	4950	2.0	5800
Tunisia	3.6	4900	2.8	6440
Libya	3.8	10000	2.0	12000
Egypt	4.6	3300	2.5	4330

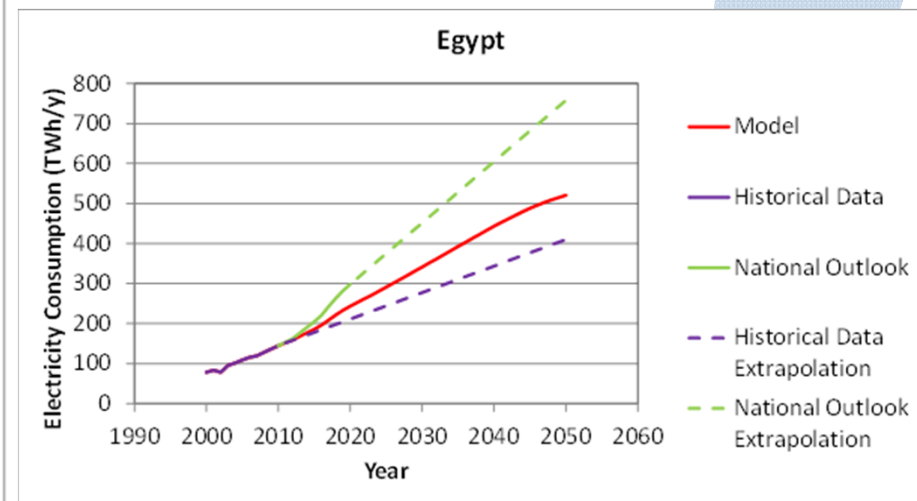
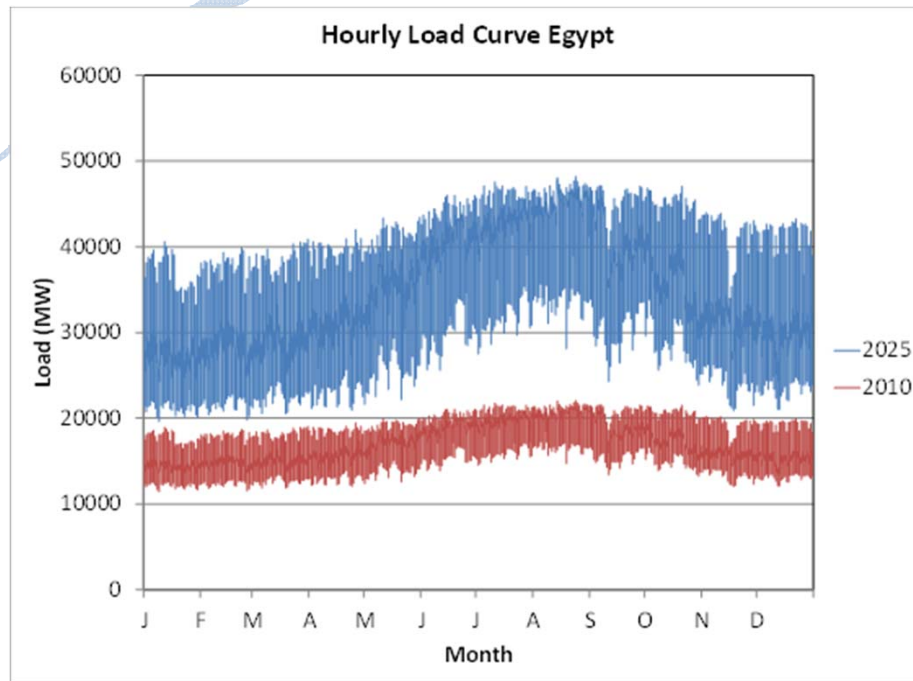


3.2. Prospects for RES-E in NA

3.2.2: Demand development scenarios



3. Annual hourly load curves identified for 2010 and scaled until 2025 (AUE 2013)
4. Demand scenarios created and compared to historical data and national outlook (AUE 2013)



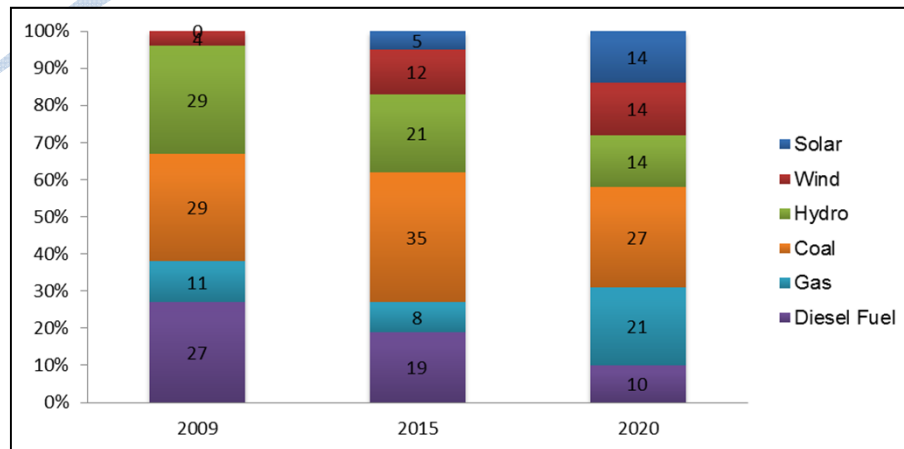
Report from April 2013

3.2. Prospects for RES-E in NA

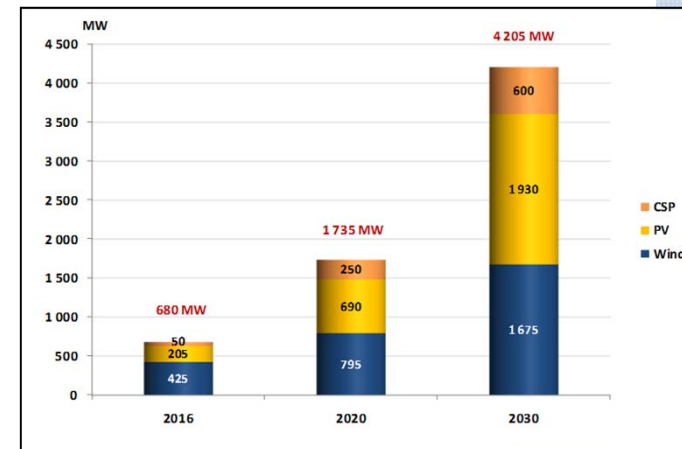
3.2.3: Policy targets



1. Targets for 2020 and in some countries for 2030
2. Bottom up-scenarios adapted to medium term targets with long-term outlook until 2050 as far as available (MASEN, NREA, STEG ...)



Share and targets of installed electricity capacities in Morocco



Targets of installed electricity capacities in Tunisia

Report from June 2013

3.2. Prospects for RES-E in NA

3.2.4: Estimated framework development



1. Affordability

- Low cost
- Low subsidies
- Low structural effort

2. Security

- Diversification of supply
- Power on demand and redundancy
- Sustainable energy resources
- Available technology

3. Environmental compatibility

- Low pollution, climate protection
- Low risks for health and nature
- Low land use and structural impacts

4. Social compatibility

- Fair access to energy
- Balance of dependencies and interdependencies
- Strategic flexibility during transition

➔ One consistent pathway towards sustainable supply under specific limitations

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3.2. Prospects for RES-E in NA

3.2.4: Estimated framework development



Important Frame Condition:

The available firm capacity must be larger than peak load

$$\sum P_{\text{installed}} \cdot CC \geq S \cdot P_{\text{load, max}}$$

$P_{\text{installed}}$

installed capacity

CC

capacity credit of each technology

$P_{\text{load, max}}$

peak load

S

security margin (e.g. 1.25 for 25% reserve capacity)

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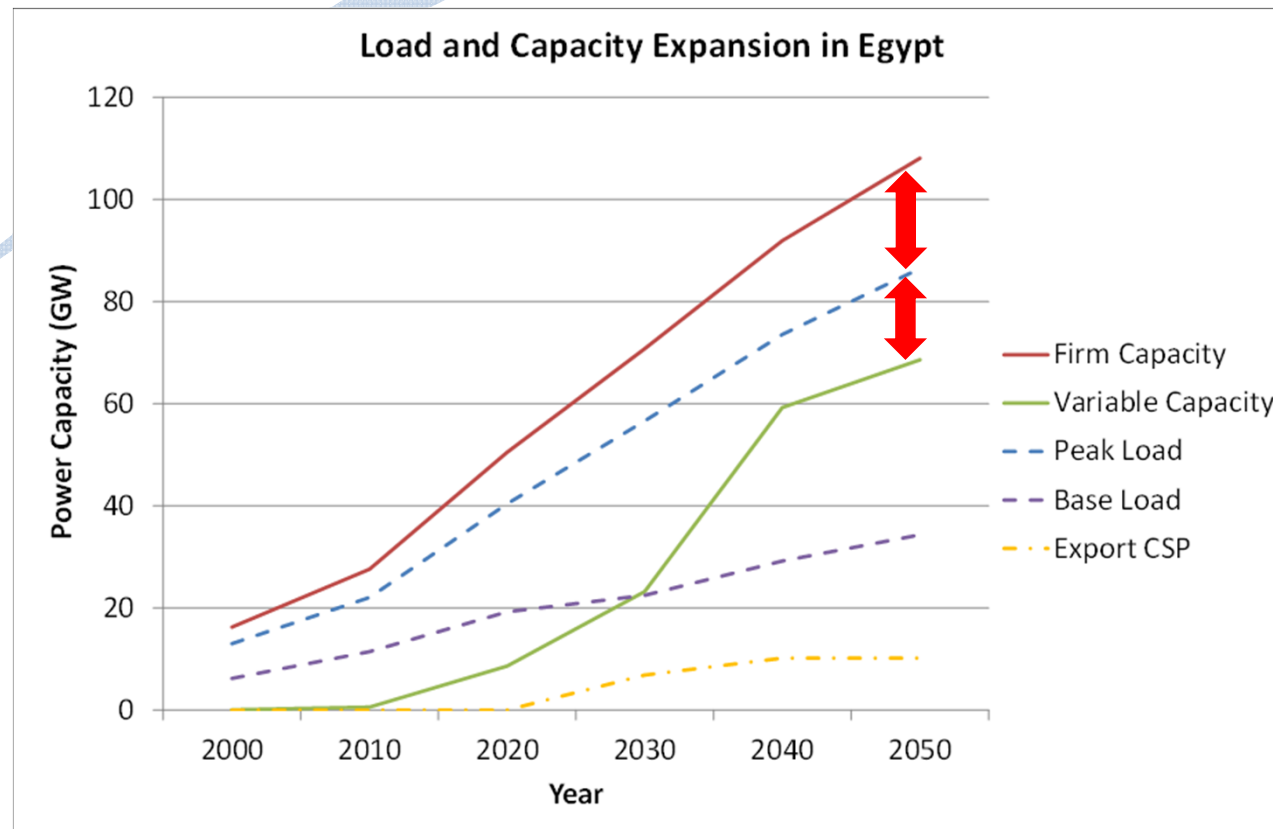
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3.2. Prospects for RES-E in NA

3.2.4: Estimated framework development



A simple rule to minimize structural effort and keep costs low:



Firm power
always larger
than peak load

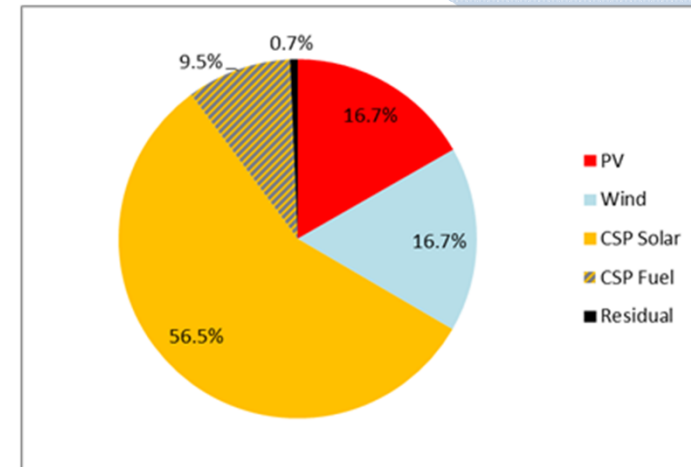
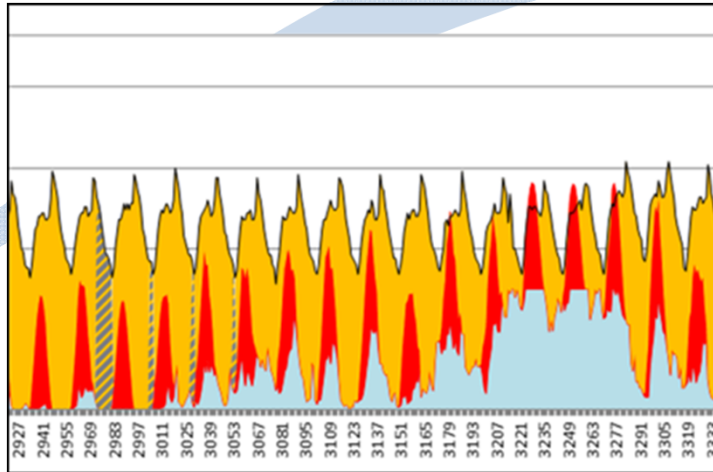
Fluctuating power
not much larger
than peak load

3.2. Prospects for RES-E in NA

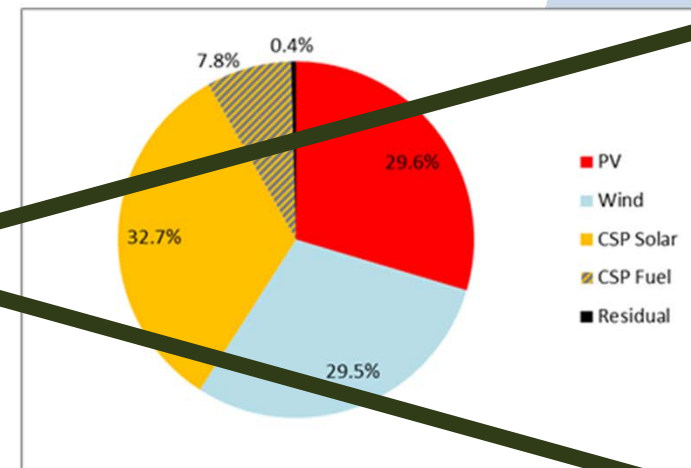
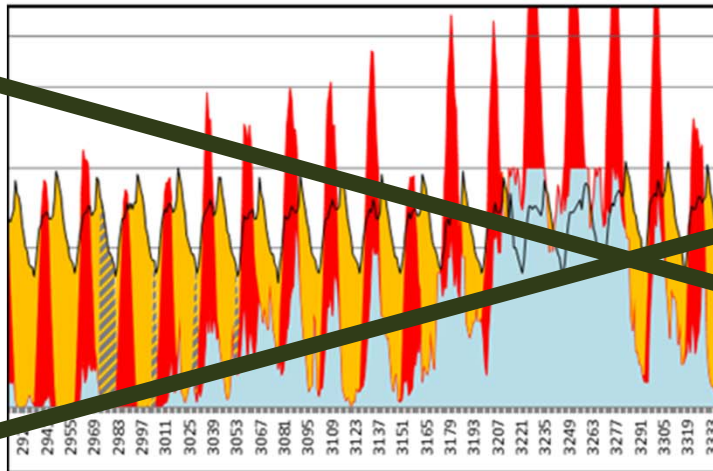
3.2.5: Bottom-up scenarios (feasible pathways)



Typical
bottom up
scenario
result

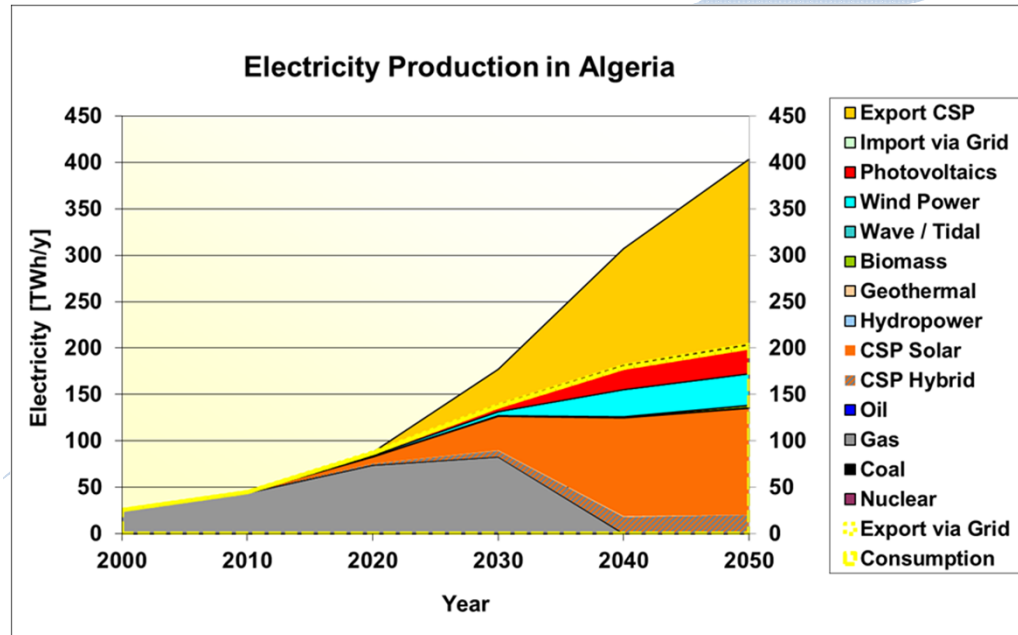


Doubling
PV and
wind
power



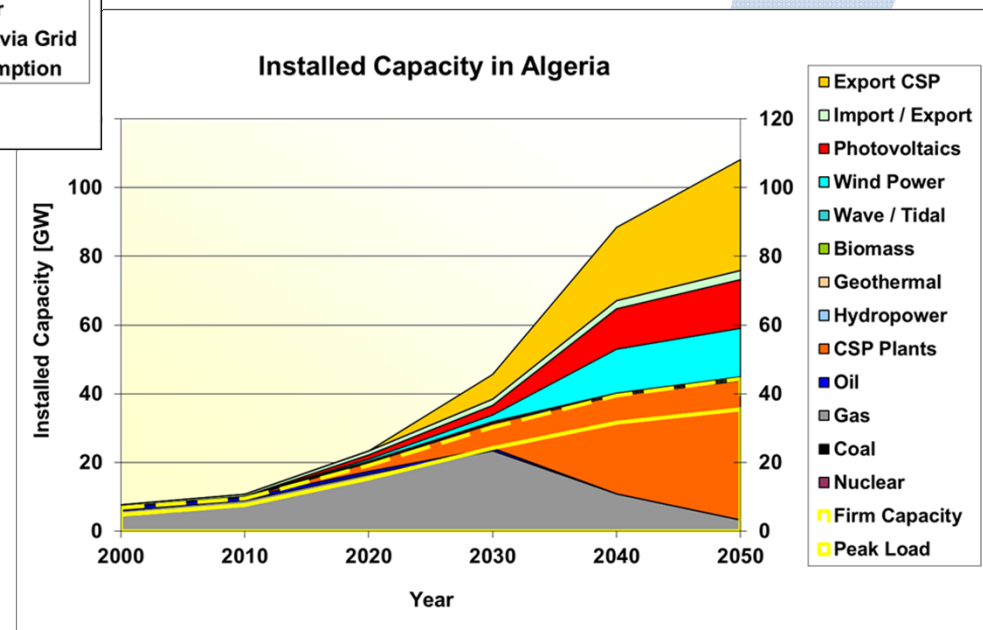
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Case Study Algeria

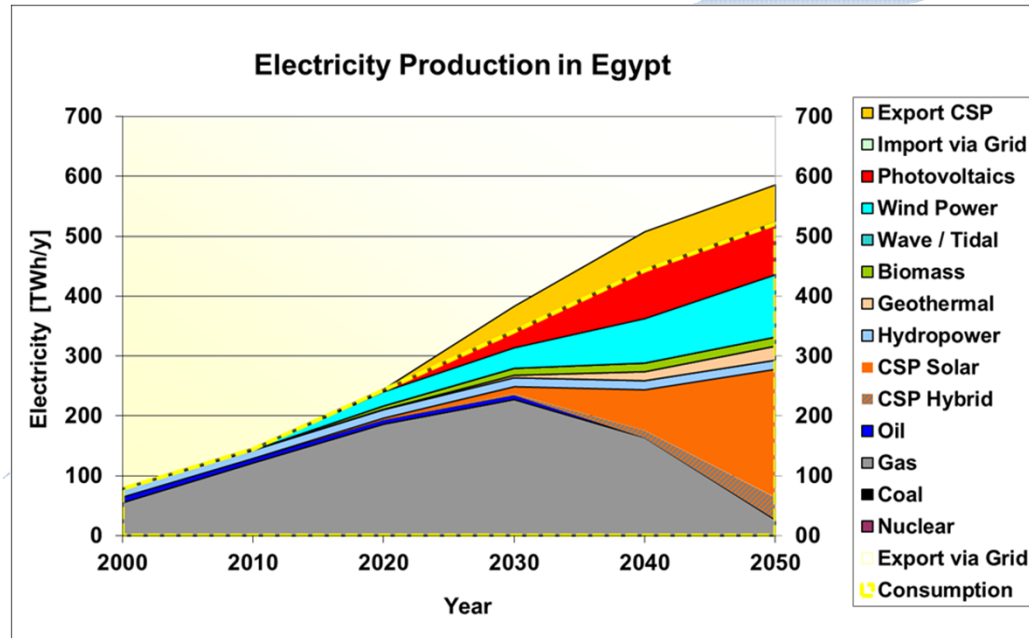
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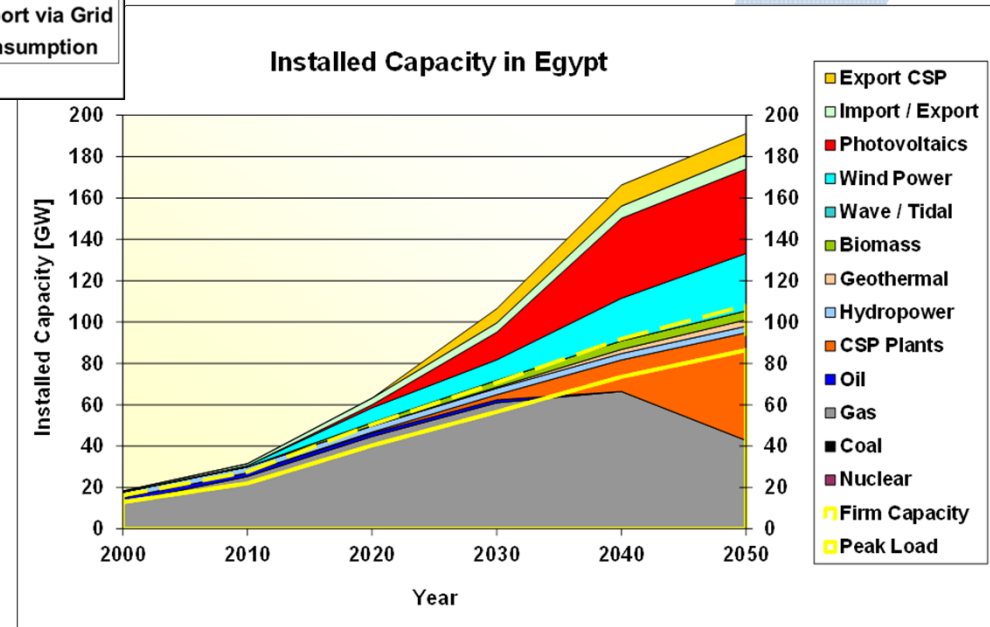
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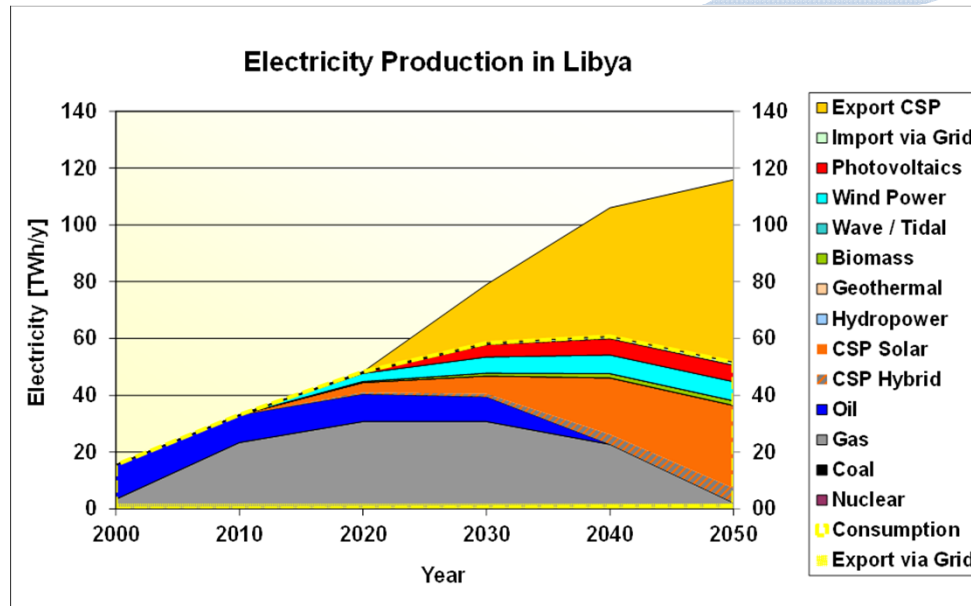
Case Study Egypt

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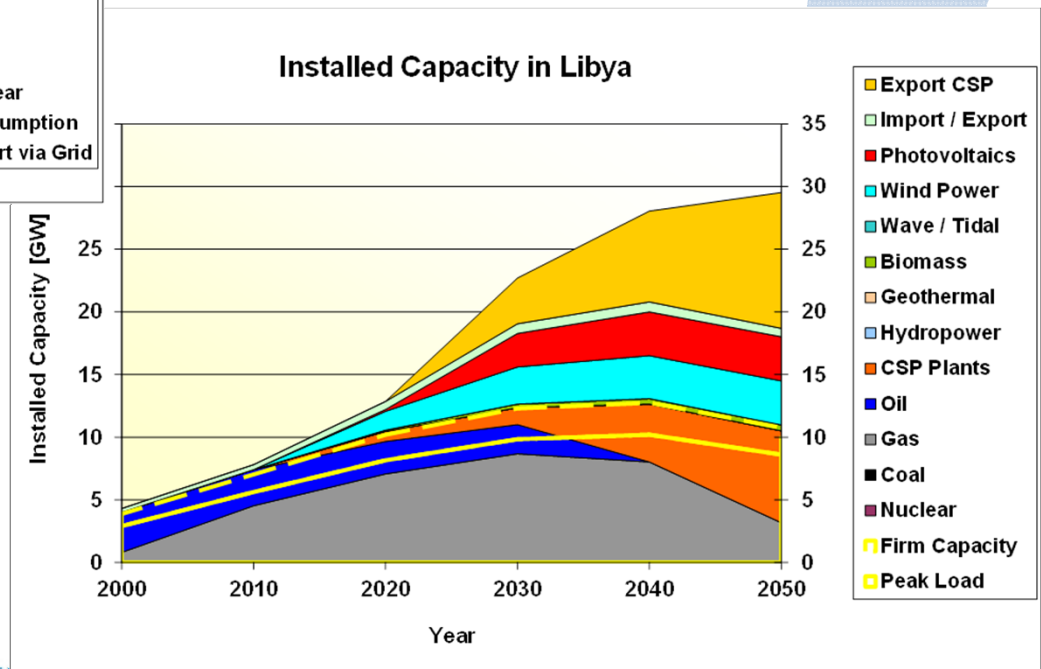


3.2. Prospects for RES-E in NA

3.2.5: Bottom-up scenarios (feasible pathways)



Case Study Libya



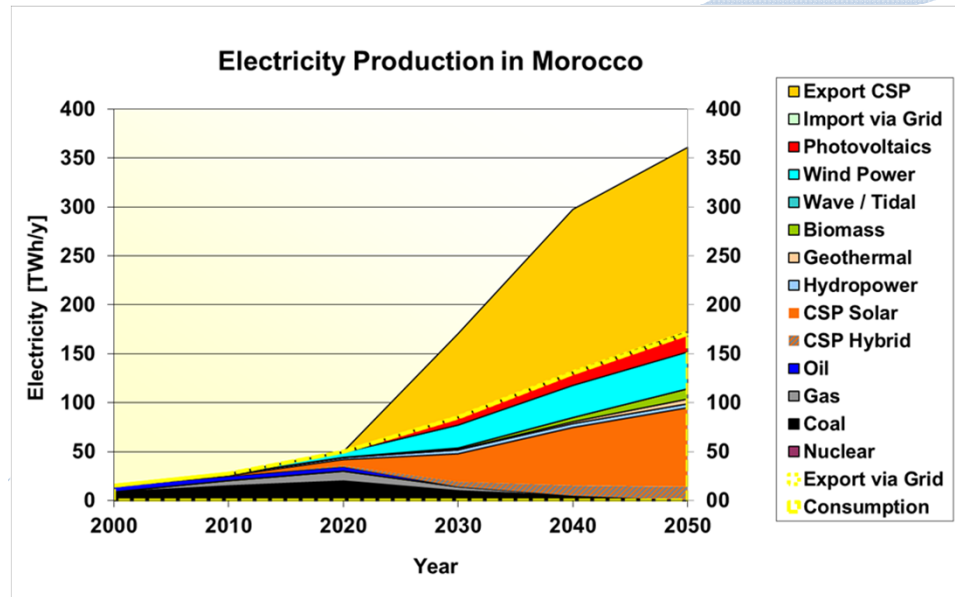
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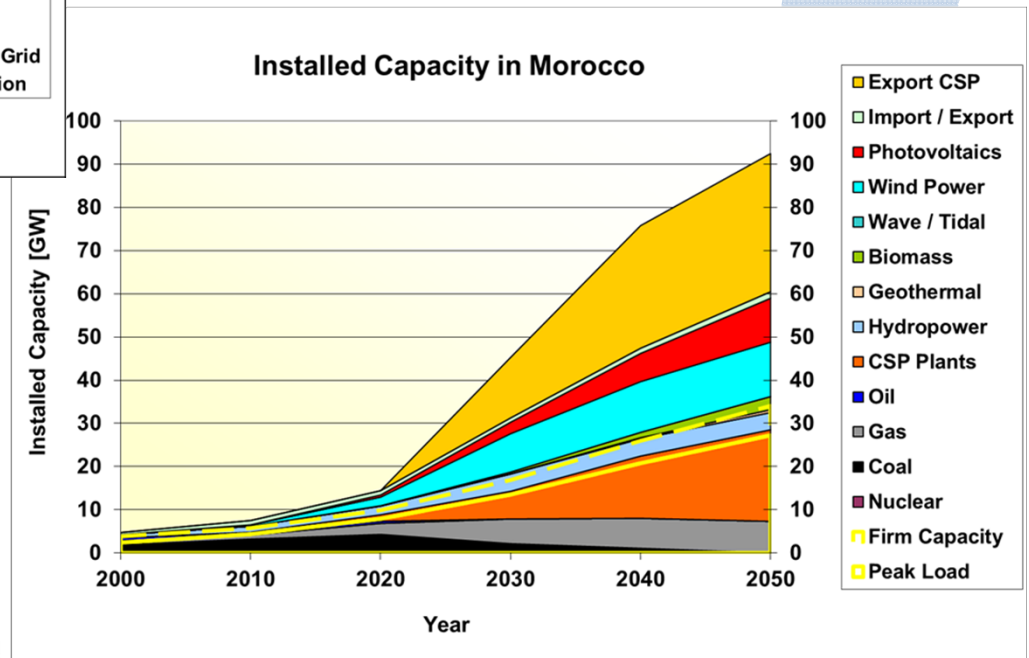
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Case Study Morocco



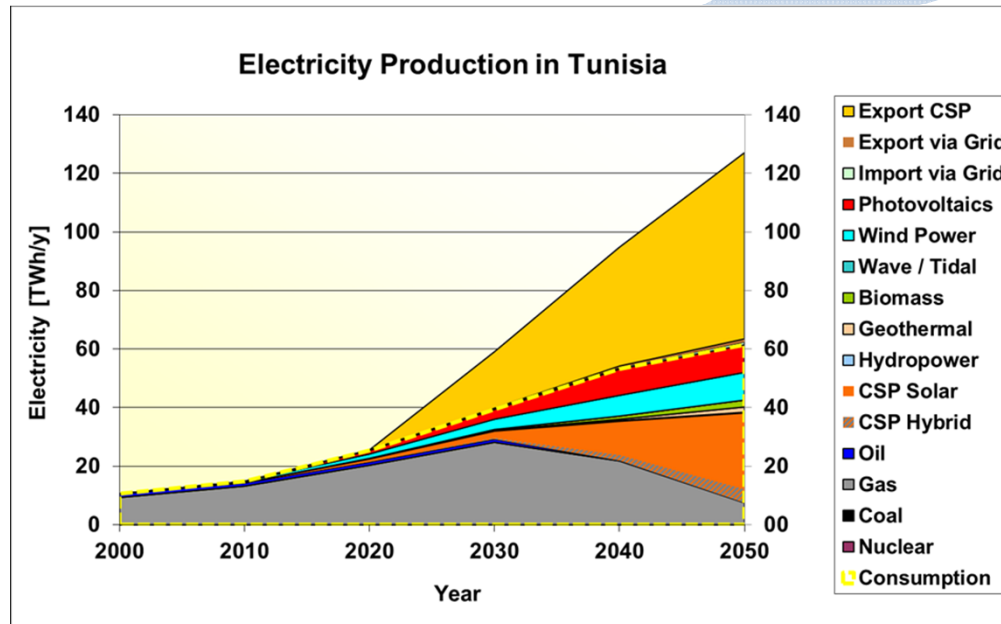
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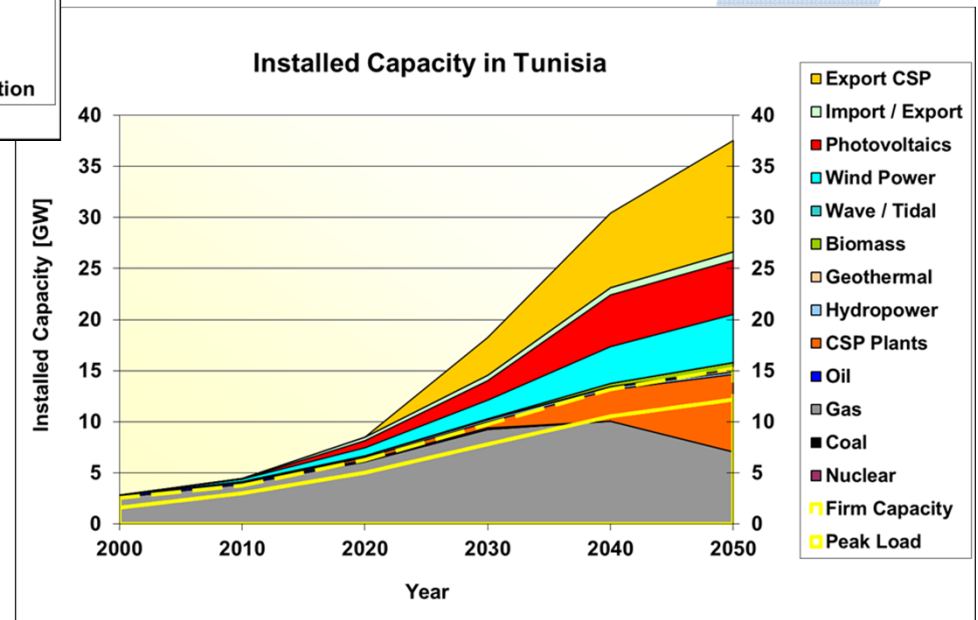
3.2. Prospects for RES-E in NA

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Case Study Tunisia

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3.2. Prospects for RES-E in NA

Conclusions and current status



- RES-E potentials have been analysed and found to be larger than in former studies
 - Electricity demand scenarios have been elaborated until 2025 and 2050
 - Short term RES-E policy targets have been identified
 - Framework conditions for sustainable supply have been defined
 - Bottom-up scenarios (feasible pathways) towards sustainability have been described (low effort approach)
- feedback needed from stakeholders about consistency with regional targets and policy

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